

Rehabilitation tools and practices for common movement disorder diseases

By Laurice Yang
West LA VA Movement Disorder Fellow
November 6, 2014



Agenda

Please Cue these videos for the presentation

Video #1

<http://youtu.be/fS01kn6YJ94>

please cue to 0:29 and will play until 0:48

Video #2

<http://youtu.be/Z3a5u6djGnE>

please cue to 5:24 and play to 8:57

Agenda

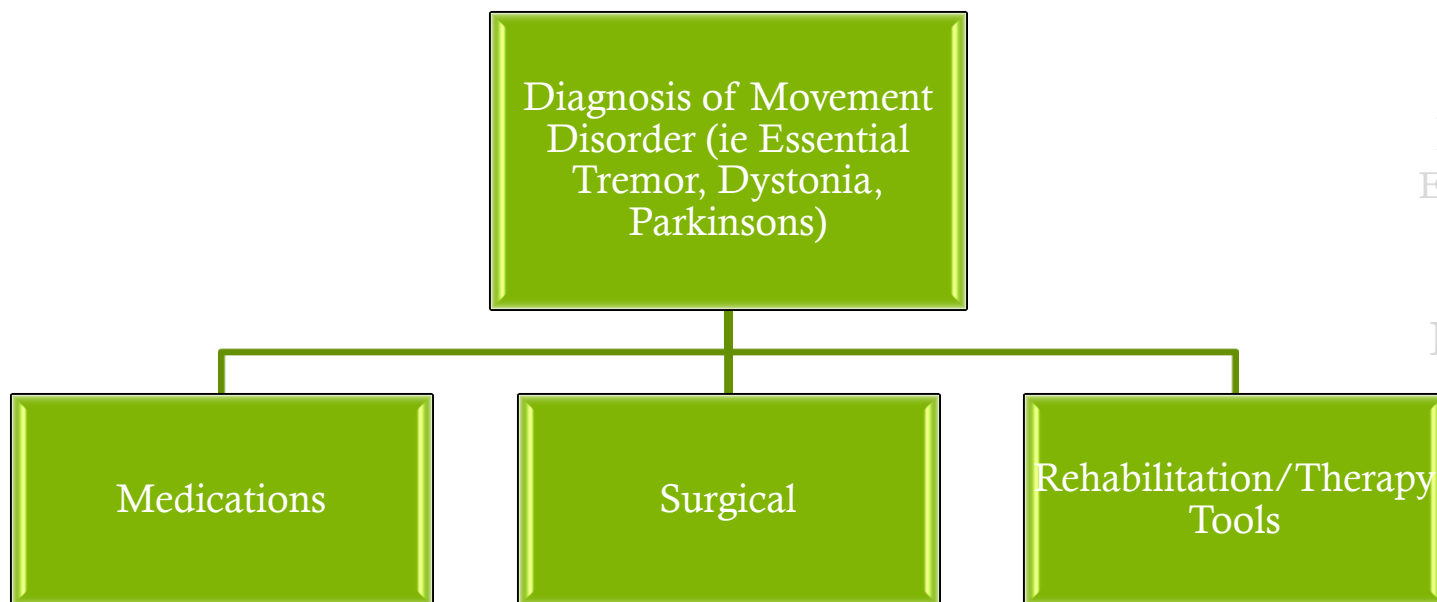
- ◆ Introduction
- ◆ Rehabilitation Tools
 - ◆ Essential Tremor
 - ◆ Parkinson's Disease
- ◆ Future Tools
 - ◆ Action Observation
 - ◆ Motor Imagery

How to Approach Movement Disorders Diseases

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

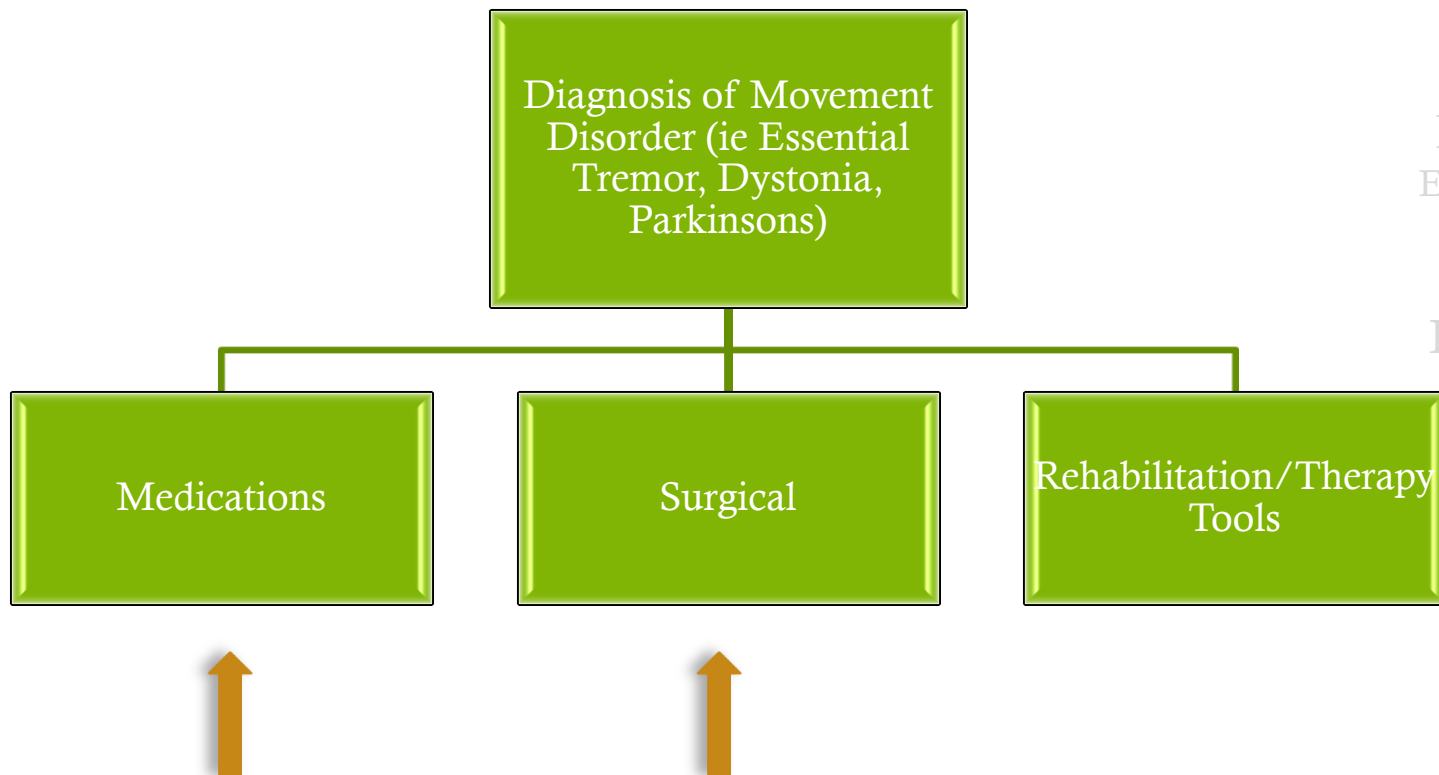


How to Approach Movement Disorders Diseases

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

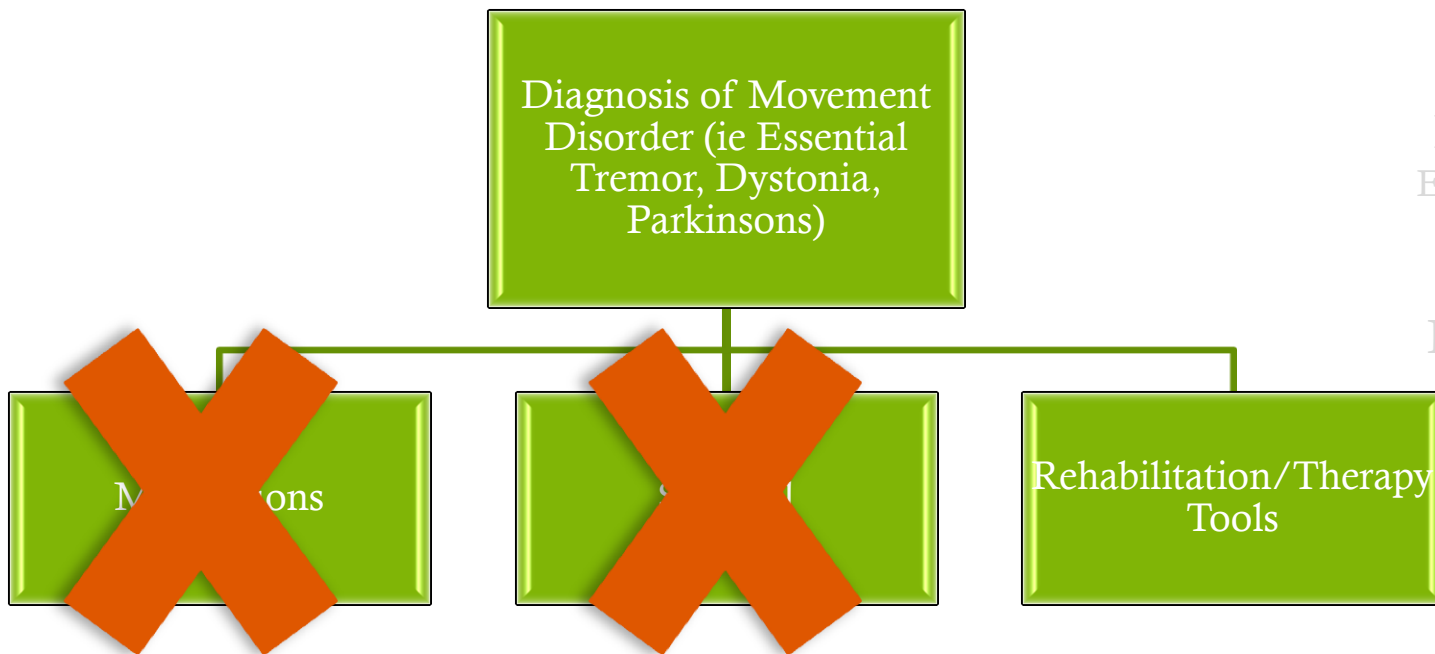


How to Approach Movement Disorders Diseases

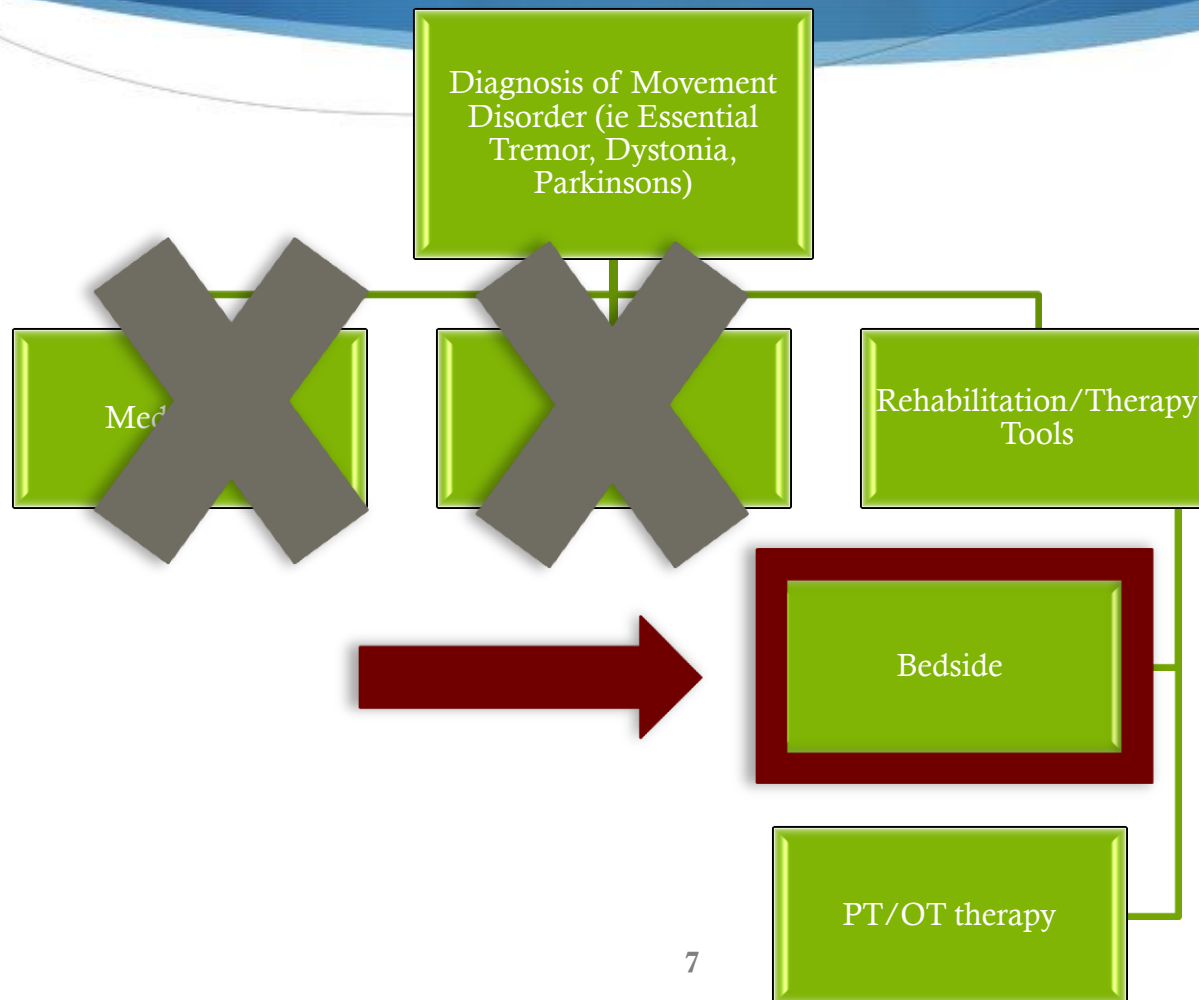
Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools



How to Approach Movement Disorders Diseases



Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehabilitation Tools

- What are some tools I can use at bedside?
 - Essential Tremor
 - Parkinson's Disease

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- ◆ Definition:
 - ◆ **Postural and/or kinetic tremor**
 - ◆ Characterized by **rhythmic shaking** that occurs during voluntary movement or while holding a position against gravity
 - ◆ Not dangerous – but can be very **debilitating**
 - ◆ Usually hands, but can also involve legs, voice and head

Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- ◆ Always ASK:
 - ◆ What activity inhibits you the most?
 - ◆ Writing
 - ◆ Eating
 - ◆ Buttoning
 - ◆ Typing

Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

💧 Writing

- 💧 How to improve writing
- 💧 Holding a pen differently!!
- 💧 Fooling the brain!!

Rehab Tools: Essential Tremor

Introduction

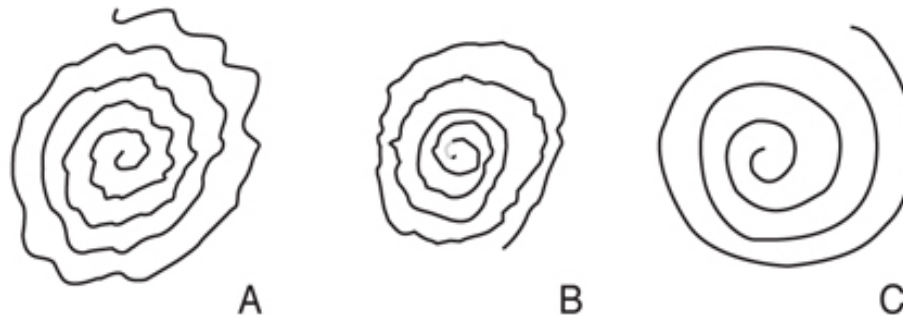
Current
Rehab Tools
Essential Tremor
PD

Future Tools

Writing

- Test tremor

- Archimedes Spiral



- How to improve writing
- Holding a pen differently!!
- Fooling the brain!!

Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

♦ Writing

- ♦ What are writing tools you can bring and/or talk about at bedside?

Rehab Tools: Essential Tremor

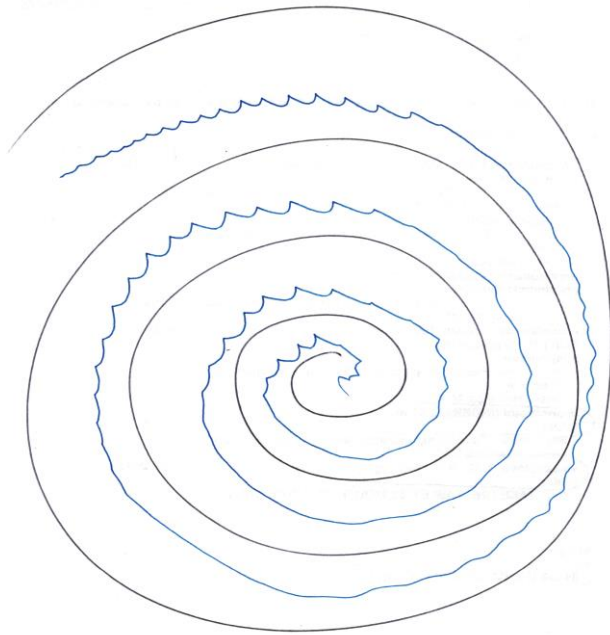
Tools at Bedside

Pen Again®



Rehab Tools: Essential Tremor

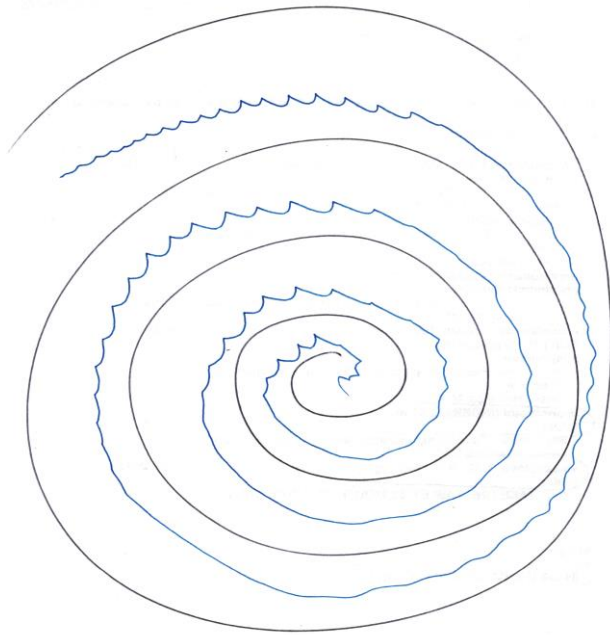
Before and After



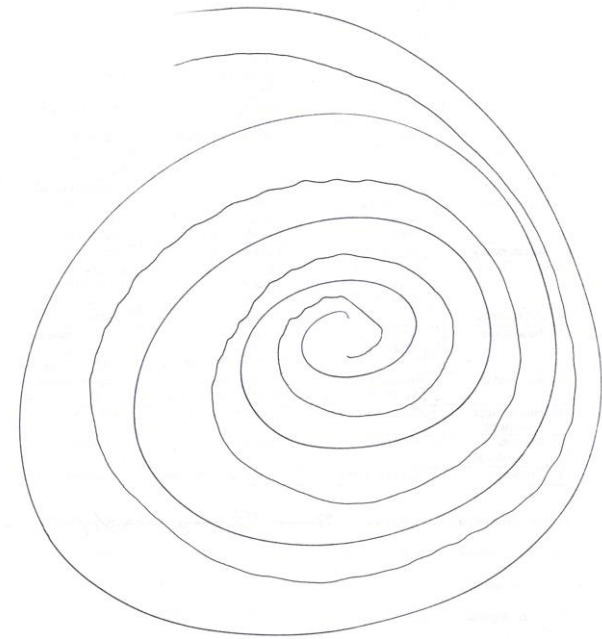
Before

Rehab Tools: Essential Tremor

Before and After



Before



After

Rehab Tools: Essential Tremor

Tools at Bedside

- Fat Pen
- Heavy Pen



Rehab Tools: Essential Tremor

Tools at Bedside

- Fat Pen
- Heavy Pen
- Heavy Utensils
- Wrist weights



Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- Writing
 - Pen Again
 - Fat pen, Heavy Pen
 - Silly Putty
 - Wrist Weights

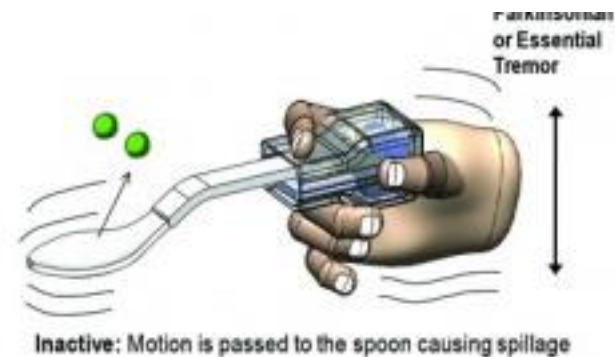
- Eating

- Buttoning

- Typing

Rehab Tools: Essential Tremor

- 💧 Eating
- 💧 Liftware



Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- 💧 Eating
 - 💧 Liftware

Video #1

- 💧 <http://youtu.be/fS01kn6YJ94>
- 💧 0:29 to 0:48

Rehab Tools: Essential Tremor

- 💧 Writing
 - 💧 Pen Again
 - 💧 Fat pen, Heavy Pen
 - 💧 Silly Putty
 - 💧 Wrist Weights
- 💧 Eating
 - 💧 Liftware
- 💧 Buttoning
- 💧 Typing

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehab Tools: Essential Tremor

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- ◆ Writing
 - ◆ Pen Again
 - ◆ Fat pen, Heavy Pen
 - ◆ Silly Putty
 - ◆ Wrist Weights
- ◆ Eating
 - ◆ Liftware
- ◆ Buttoning
- ◆ Typing

Rehab Tools: Essential Tremor

- Buttoning
- Magna Ready®



Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehab Tools: Essential Tremor

- ◆ Buttoning
- ◆ Other adaptive clothing



Propét



Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehab Tools: Essential Tremor

Introduction

**Current
Rehab Tools**
Essential Tremor
PD

Future Tools

- ◆ Writing
 - ◆ Pen Again
 - ◆ Fat pen, Heavy Pen
 - ◆ Silly Putty
 - ◆ Wrist Weights
- ◆ Eating
 - ◆ Liftware
- ◆ Buttoning
 - ◆ magnet button shirts
 - ◆ Velcro pants and shoes
- ◆ Typing

Rehab Tools: Essential Tremor

- ◆ Typing
 - ◆ Big Keys



Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehab Tools: Essential Tremor

◆ Writing

- ◆ Pen Again
- ◆ Fat pen, Heavy Pen
- ◆ Silly Putty
- ◆ Wrist Weights

◆ Eating

- ◆ Liftware

◆ Buttoning

- ◆ magnet button shirts
- ◆ Velcro pants and shoes

◆ Typing

- ◆ Big Keys Keyboard

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Rehab Tools: Parkinson's Disease

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- ◆ Parkinson's disease
 - ◆ Rigidity, bradykinesia and rest tremor
 - ◆ Gait abnormalities
 - ◆ Freezing gait
 - ◆ Temporary involuntary inability to move legs
 - ◆ Feeling “stuck” to the ground

Rehab Tools: Parkinson's Disease

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

- ◆ Parkinson's disease
 - ◆ Things to do for Freezing Gait
 - ◆ **Marching** - high knee step
 - ◆ **Counting Out Loud**, stepping into a rhythm

Rehab Tools: Parkinson's Disease

Introduction

Current
Rehab Tools
Essential Tremor
PD

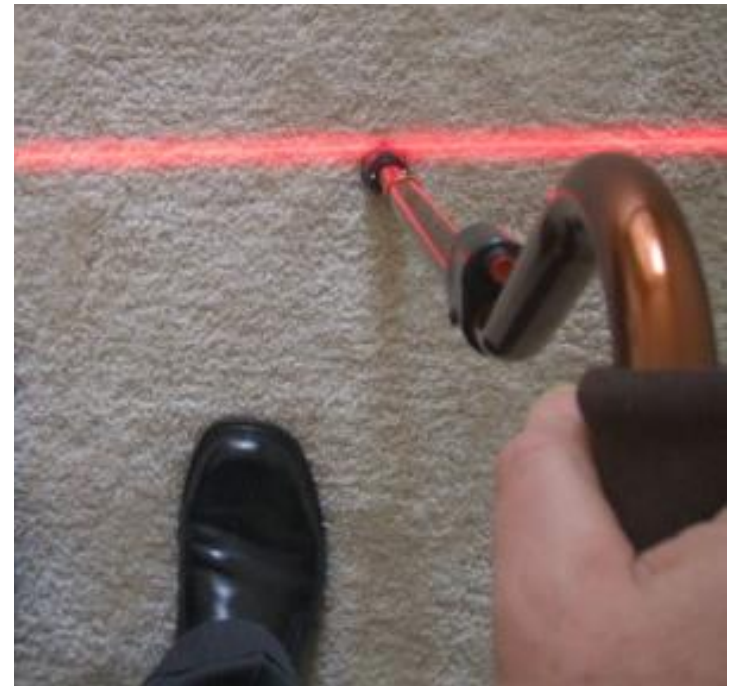
Future Tools

- ◆ Parkinson's disease
 - ◆ Things to do for Freezing Gait
 - ◆ **Marching** - high knee step
 - ◆ **Counting Out Loud**, stepping into a rhythm
 - ◆ **U step Walker**
 - ◆ **U step Cane**

Rehab Tools: Parkinson's Disease



- ◆ Parkinson's disease
 - ◆ U step Walker
 - ◆ U step Cane



Agenda

- ◆ Definitions
 - ◆ Essential Tremor, Dystonia, and Parkinson's disease
- ◆ Rehabilitation Tools
 - ◆ Essential Tremor
 - ◆ Dystonia
 - ◆ Parkinson's Disease
- ◆ Future Tools
 - ◆ Action Observation
 - ◆ Motor Imagery
 - ◆ Neuroimaging Feedback

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools

Future Tools

- ◆ **Action Observation and Motor Imagery**
 - ◆ Action Observation – watching others perform
 - ◆ Motor imagery – imaging motor tasks

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Action Observation

- ◆ **Action observation**

- ◆ Influences motor performance

- ◆ **Athletes**

- ◆ Basketball Freethrows Corbin (1972)

- ◆ **Musicians**

- ◆ Increase in performance Leone et al 1995

- ◆ **Other neurological disease**

- ◆ Strokes - Erteit, et al

- ◆ Children with cerebral palsy (Kim, et al)

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Action Observation

- Helps with **Functional Reorganization**
- Action Observation activities play an important role in **human development**
 - Toddlers and infants

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Action Observation

◆ Action observation

- ◆ PD patients (Pelosin et al)
- ◆ Bradykinesia improved with VIDEO or ACOUSTIC
 - ◆ VIDEO – clip showing repetitive finger movements at 3Hz
 - ◆ ACOUSTIC – listened paced 3Hz

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Action Observation

◆ Action observation

- ◆ PD patients (Pelosin et al)
- ◆ Bradykinesia improved with VIDEO or ACOUSTIC
 - ◆ VIDEO – clip showing repetitive finger movements at 3Hz
 - ◆ ACOUSTIC – listened paced 3Hz
- ◆ Both interventions improved bradykinesia
 - ◆ training with VIDEO was more effective than acoustic training in modifying the performance of repetitive finger movements at longer intervals

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Action Observation

- Action Observation in PD
 - Freezing Gait
 - Increased falls, Negative Impact on QoL
- Methods
 - 20 patients
 - Videos – walking by PT
 - Vs control – pictures of landscape

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Action Observation

- Action Observation in PD
 - Freezing Gait
 - Increased falls, Negative Impact on QoL
- Methods
 - 20 patients
 - Videos – walking by PT
 - Vs control – pictures of landscape
- Significant **DECREASE** of Freezing Gait
 - Walking and balance tests
 - QoL improved as well

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- ◆ **Motor Imagery** is a cognitive process
 - ◆ Subject images that he/she performs a movement without actually performing the movement
 - ◆ Requires the **conscious activation** of brain regions involved in movement preparation and execution

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- Fast growing number studies indicate that the **brain areas engaged** in the **ACTUAL PERFORMANCE**, also were **active** during **MOTOR IMAGERY** (Hallett 1994, Lotze 1999, Kimberley 2006)

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- ◆ Meister et al 2004
 - ◆ Musicians who **played piano “in their mind”**
 - ◆ Activated
 - ◆ LEFT primary sensorimotor area
 - ◆ Left cerebellum
 - ◆ Premotor/supplementary motor areas
 - ◆ **Everything that is activated** in actual action except for primary sensorimotor area and right cerebellum

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- ◆ Stippich et al (2002) showed imagination of different moving body parts
 - ◆ Foot, hand and tongue
 - ◆ Activated **precentral gyrus** in a somatotopic manner

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- ◆ Stippich et al (2002) showed imagination of different moving body parts
 - ◆ Foot, hand and tongue
 - ◆ Activated **precentral gyrus** in a somatotopic manner
- ◆ Ehrsson et al (2003)
 - ◆ **Finger movement** activated finger area
- ◆ **Vitals** (HR and respiratory rate)
 - ◆ Imagined and actual movements

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- ◆ Page (2000)
 - ◆ 4 week training , 8 hemiparetic right arm from strokes
 - ◆ The results indicated that the **stroke patients**
 - ◆ who received the combined program improved **significantly more** than those who received only occupational therapy

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- Tamir 2007
 - Reported **improved motor scores (UPDRS)** and ADLs score
 - With motor imagery + PT than PT alone

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

◆ Liu 2004

- ◆ The patients in the **motor imagery group** did improve on neuropsychological tasks measuring **attention**
- ◆ their capacity in **attentive processing** had been improved as a result of the mental imagery training.

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery

- ◆ Linden et al 1989
 - ◆ Reported **better equilibrium** characteristic in elderly women as measured by walking balance and foot placement
 - ◆ As a result of **motor imagery and PT**

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Neuroimaging

- ◆ Action observation and Motor imagery

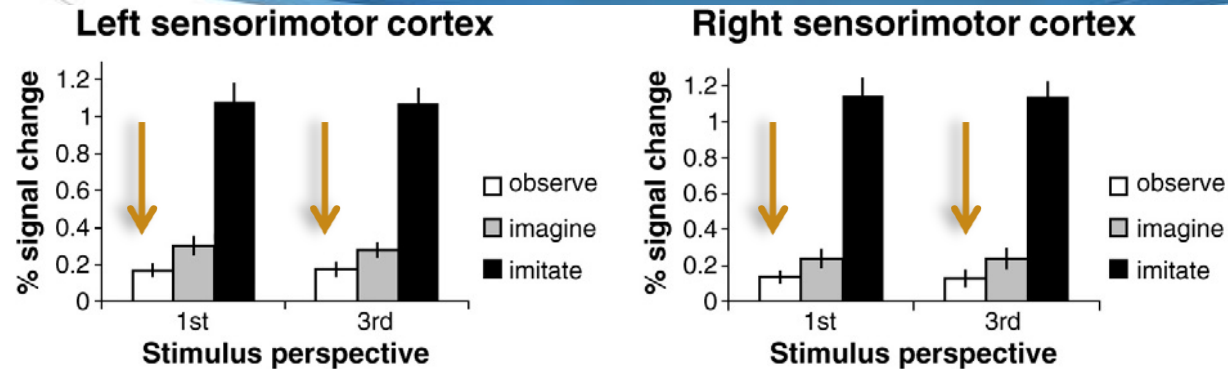
- ◆ Engage in the same neural structures involved in movement execution.
- ◆ But can this be supported with **Imaging**?

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Neuroimaging

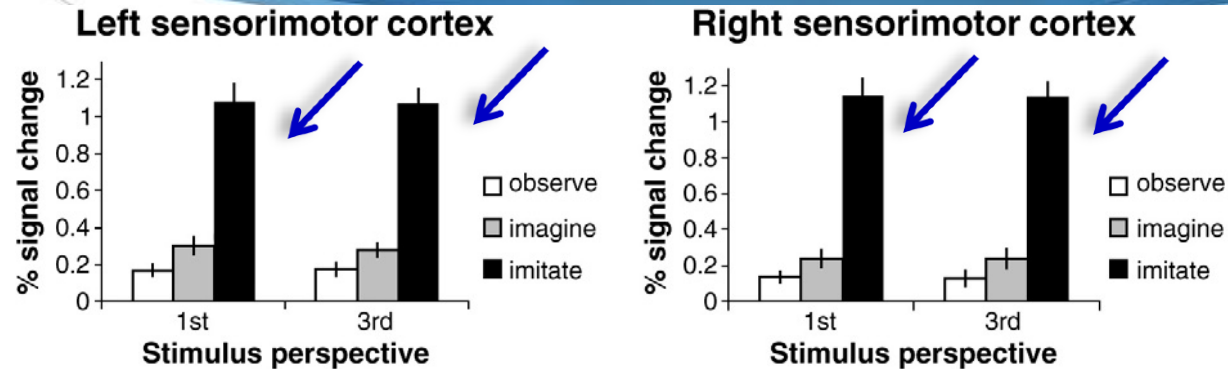


Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Neuroimaging



Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

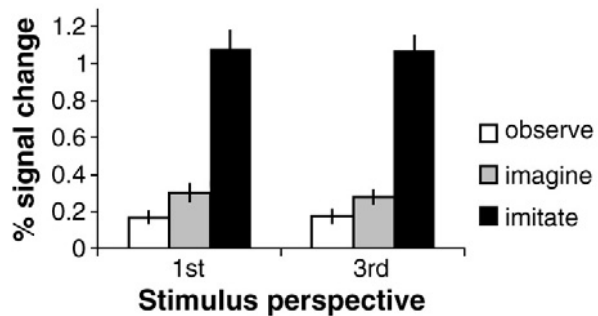
Neuroimaging

Introduction

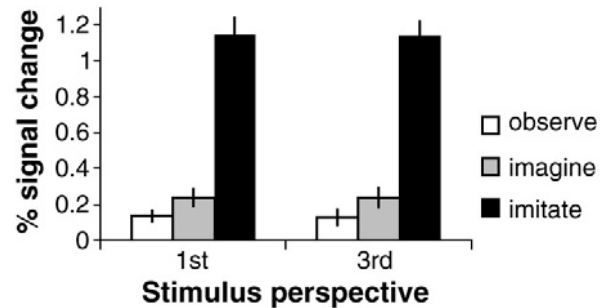
Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

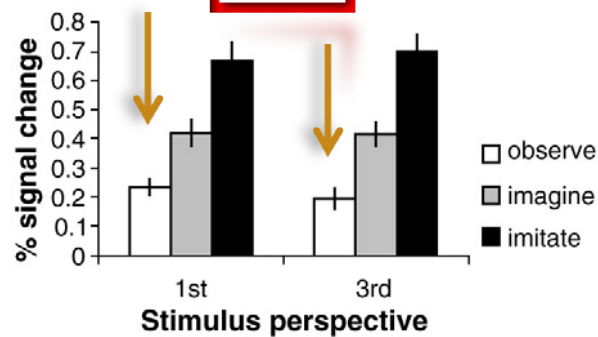
Left sensorimotor cortex



Right sensorimotor cortex



SMA



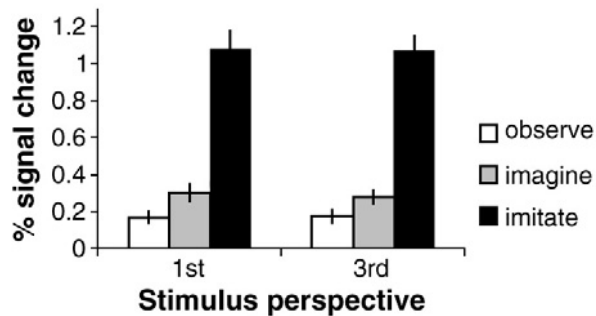
Neuroimaging

Introduction

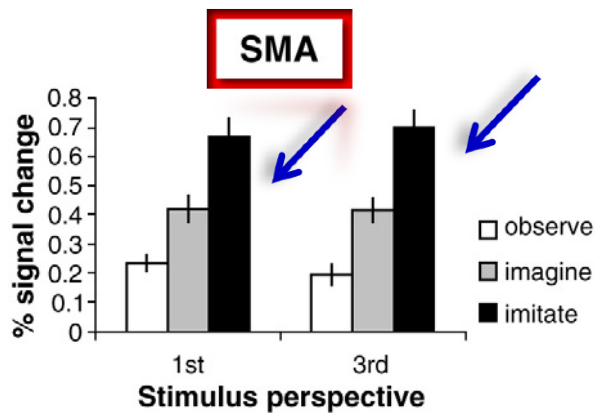
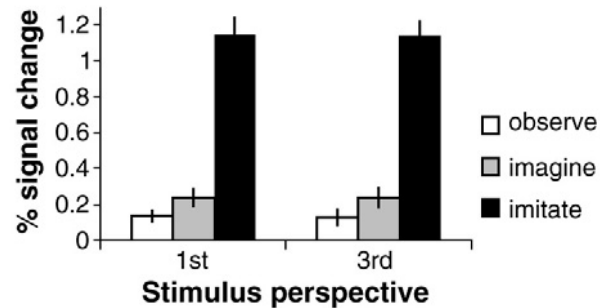
Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Left sensorimotor cortex



Right sensorimotor cortex



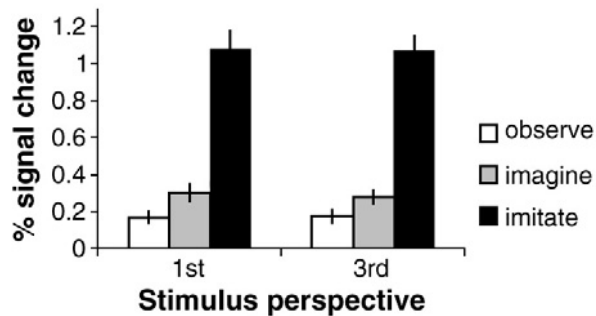
Neuroimaging

Introduction

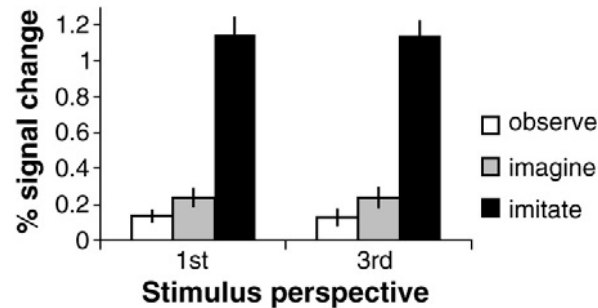
Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

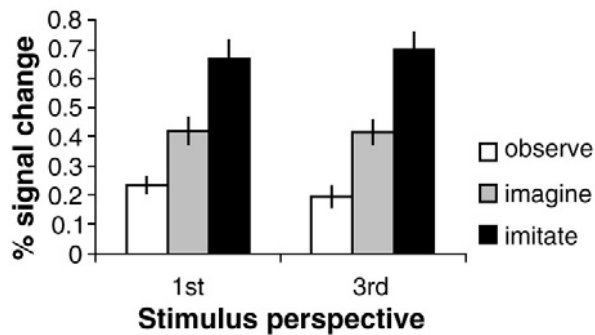
Left sensorimotor cortex



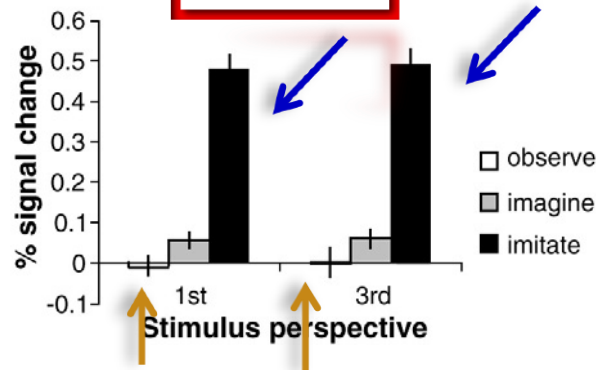
Right sensorimotor cortex



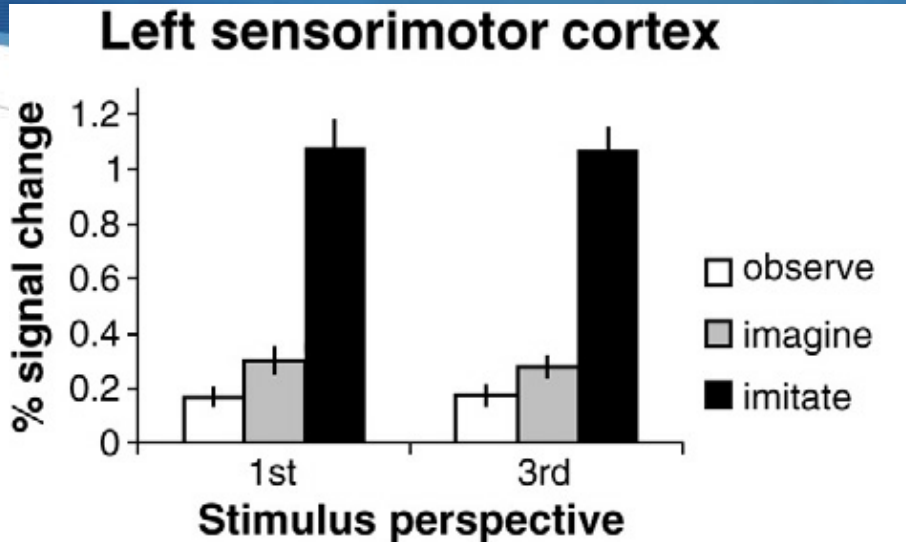
SMA



Cerebellum



Neuroimaging



- Hierarchy increased activity during **observation** are a **SUBSET** of those engaged in **motor imagery**
- In turn – a **subset** of those engaged in **imitation**
- **Imagery** thus provides a **MORE EFFECTIVE** means of driving neural activity in these areas

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Neuroimaging

- ◆ This raises the questions ---
- ◆ Can we use **neuroimaging** as a rehab tool?

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Real time fMRI Feedback

- ◆ Neurofeedback training
- ◆ **REAL TIME** brain activation
- ◆ Parkinson's patients
 - ◆ 5 experiment, 5 controls
- ◆ fMRI neurofeedback session

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Real time fMRI Feedback

◆ Localizer Run

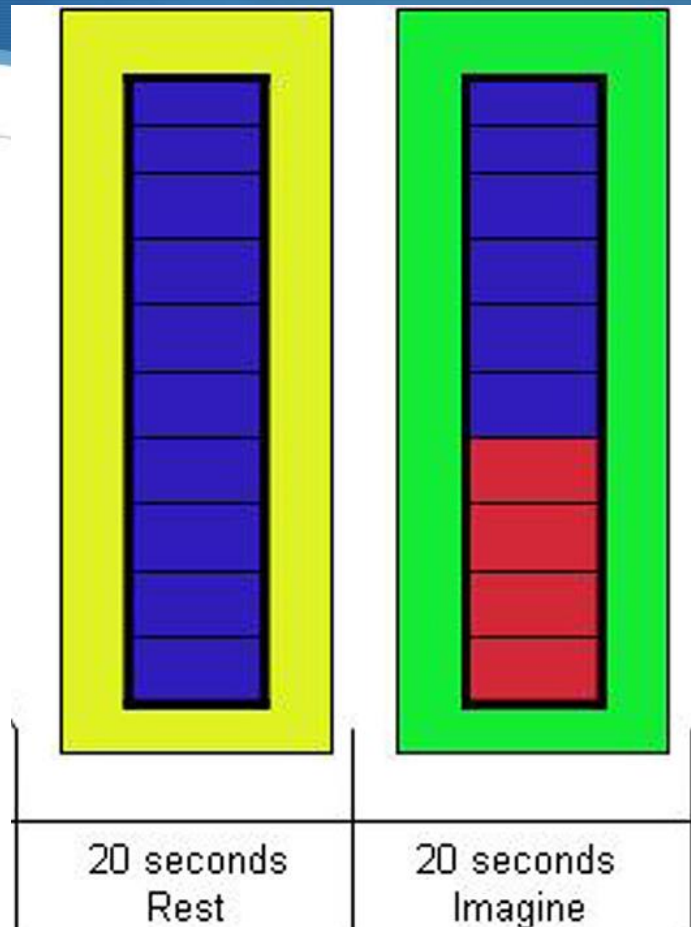
◆ Visual Feedback Sessions

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Real time fMRI Feedback



Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Real time fMRI Feedback

- ◆ Session 1 → Session 3 (2-6 months later)
- ◆ In between scans – they were asked to daily think about the **activity** that achieved the **highest fMRI reading**

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Real time fMRI Feedback

◆ Clinical outcomes

- ◆ Motor UPDRS : 14.2 → 9
- ◆ Finger tapping test
 - ◆ Finger tapping device – would count number of taps
 - ◆ Timed for one minute: 210 → 266

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Real time fMRI Feedback

💧 Discussion

- 💧 PD patients can increase activity in the SMA by motor imagery with the help of real time neurofeedback training
- 💧 Followup 2 months – still had good results (re: UPDRS and finger tapping)
- 💧 Increase motivation

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery in Rehab

- ◆ Raise the possibility
 - ◆ Could we use **motor imagery** could be used for control of **external devices** by using the output signal created by imagination as input signal for a machine

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Motor Imagery in Rehab

Dr Geoffrey Ling

Video #2

<https://www.youtube.com/watch?v=Z3a5u6djGnE>

Queue at 6:12, Stop 9:02

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Action
Observation
Motor Imagery
Neuroimaging

Conclusion

- ◆ Rehabilitation starts at the bedside clinical assessment
 - ◆ Tools
 - ◆ Education
 - ◆ Working with physical therapy
- ◆ Future rehab tools
 - ◆ Action Observation
 - ◆ Motor Imagery
 - ◆ Neuroimaging

Questions?

References

- Butler AJ, Page SJ (2006) *Mental practice with motor imagery: evidence for motor recovery and cortical reorganization after stroke*. Arch Phys Med Rehabil 87 (Suppl 12) 2: 2–11
- Corbin C (1972) Effects of mental practice on skill development after controlled practice. In: Morgan W (ed) Ergogenic aids and muscular performance. Academic Press, New York, pp 93–118
- Ehrsson H, Geyer S, Naito E (2003) Imagery of voluntary movement of fingers, toes, and tongue activates corresponding bodypart specific motor representations. J Neurophysiol 90: 3304–3316
- Hallett M, Fieldman J, Cohen LG, Sadato N, Pascual-Leone A (1994) Involvement of primary motor cortex in motor imagery and mental practice. Behav Brain Sci 17: 210
- Kimberley TJ, Khandekar G, Skraba LL, Spencer JA, Van Gorp EA, Walker SR (2006) Neural substrates for motor imagery in severe hemiparesis. Neurorehabil Neural Repair 20: 268–277
- Linden CA, Uhley JE, Smith D, Bush MA (1989) The effects of mental practice on walking balance in an elderly population. Occupat Ther J Res 9: 155–169
- Liu KP, Chan CC, Lee TM, Hui-Chan CW (2004) Mental imagery for promoting relearning for people after stroke: a randomized controlled trial. Arch Phys Med Rehabil 85: 1403–1408
- Lotze M, Cohen LG (2006) Volition and imagery in neurorehabilitation. Cogn Behav Neurol 19: 135–140
- Macuga, K. Frey, S., (2012) Neural Representation involved in observed, imaged, and imitated actions are dissociable and hierarchically organized. Neuroimage. 59: 2798-2807
- Pelosin E, Avanzino L, Bove, M., Nieuwboer, A., and Abbruzzese, G. (2010). Action Observation Improves Freezing of Gait in Patients with Parkinson's Disease. Neurorehabil Neural Repair 24:746
- Stippich C, Ochmann H, Sartor K (2002) Somatotopic mapping of the primary sensorimotor cortex during motor imagery and motor execution by functional magnetic resonance imaging. Neurosci Lett 331: 508–514